Better Harvests
through Conservation Farming

U. S. DEPARTMENT OF AGRICULTURE
• SOIL CONSERVATION SERVICE •

This booklet presents some of the results that have been obtained in recent years through contour cultivation and terracing in the Southwest and the southern Great Plains. It covers studies made by the Soil Conservation Service in cooperation with the State agriculture experiment stations of Texas, New Mexico, Oklahoma, and Kansas. Data are presented on cottonfields in the Texas Panhandle, on bean lands in a mountain valley of New Mexico, on wheatfields in seven areas of the southern Great Plains, and on grain-sorghum lands in the High Plains section of Texas.

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Better Harvests
Through Conservation Farming

By R. E. Uhland, *principal soil conservationist, Research—Operations, Soil Conservation Service*

In regions of low rainfall, where water at the plant roots spells the difference between good harvests and crop failure, evidence is piling up to show that conservation farming practices frequently mean better crop yields. By storing more rainfall in the ground, contour tillage and, especially, terracing help to bring forth more pounds of cotton or more bushels of grain from a given acre of land. Since these same practices are also valuable in controlling erosion they are clearly among the most useful farming measures ever introduced in dry-land agriculture.

It should be added that the two practices go well together. Contour tillage without terracing is an effective means of checking run-off and controlling erosion only on the gentlest slopes. Where there is any prospect of considerable run-off, the contour rows should be buttressed by terraces for adequate soil protection.

Contouring, on the other hand, is one of the least expensive and most effective methods of maintaining terraces in good working condition. Performing all tillage operations parallel with terraces results in minimum damage to the terrace ridges and helps to keep them built up to the proper height.

On pages 4 and 5 are graphic summaries showing the benefits of contouring and terracing on crop yields of cotton, beans, wheat, and grain sorghum. A more detailed explanation of how these results were obtained will be found in the remaining pages of this booklet.

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Conservation farming practices, by holding rainfall on the land and storing it in the soil help to produce better crop yields.

How the Results Were Obtained

Cotton in the Texas Panhandle

On the grounds of the conservation experiment station at Spur, Tex., in the southern part of the Panhandle, are two adjacent 10-acre fields that have been planted to cotton every year since 1926. To the untrained eye they appear perfectly flat, but both have a fall of about 6 inches in every 100 feet. On one field all plowing and cultural operations have been up and down this gentle grade; the other field was terraced on the level in 1926 and has been farmed parallel with the terrace channels ever since. The soil on both fields is Abilene clay loam, a comparatively tight type common in the southern Great Plains.

The terraces built with closed ends so as to hold water on the land, rather than drain it off, have proved remarkably efficient in soil and water conservation. Over the 12-year period 1927–38 the terraced field did not lose any measurable amount of soil or

water. The unterraced field lost considerable quantities of soil and 11.57 percent of all the rain that fell.

The following table shows water losses and yields of lint per acre for both fields during the period of the experiments (table 1). It will be noticed that there was no crop at all in 3 of the 12 years. In 1929 and 1932 all crops at the station were destroyed by hail, while in 1934 the cumulative effect of 2 extremely dry years in succession was a complete crop failure. In 1936 the harvest was light because nearly half the year's supply of rain came in September, too late to be of much benefit. More important, however, is the fact that the terraced field produced consistently better yields than the unterraced field. On an average, counting in the years of crop failure, it produced 68 more pounds of lint per acre and brought in $7.60 more cash per acre per year.

TABLE 1.—*Run-off and cotton yield 1927–38, at Spur, Tex., from two 10-acre fields, one with closed level terraces and the other not terraced, and the value of the extra yields gained by terracing.*

Year	Rainfall	Water lost as run-off				Yield of lint per acre			Price obtained per 100 pounds[1]	Value of extra yield per acre
		From field not terraced		From terraced field		From field not terraced	From terraced field	Margin in favor of terracing		
	Inches	Inches	Percent	Inches	Percent	Pounds	Pounds	Pounds	Dollars	Dollars
1927	16.12	0.38	2.36	0	0	239	279	40	22.75	9.10
1928	19.99	2.88	14.41	0	0	58	217	159	16.63	26.44
1929	14.76	2.52	17.07	0	0	0	0	0	--------	0
1930	18.60	1.49	8.91	0	0	9	104	95	8.20	7.79
1931	16.46	.36	2.19	0	0	186	229	43	5.61	2.41
1932	27.70	2.83	10.22	0	0	0	0	0	--------	0
1933	15.59	.90	5.77	0	0	325	441	116	10.91	12.65
1934	12.88	.79	6.13	0	0	0	0	0	--------	0
1935	23.78	3.06	12.87	0	0	118	270	152	11.18	16.99
1936	24.37	3.98	16.33	0	0	39	55	16	8.39	1.34
1937	20.28	4.16	20.51	0	0	186	292	106	6.62	7.02
1938	19.24	3.24	16.84	0	0	147	236	89	8.42	7.49
Total	229.77	26.59	--------	0	0	1,307	2,123	816	--------	91.23
Annual average	19.15	2.22	11.57	0	0	109	177	68	11.18	7.60

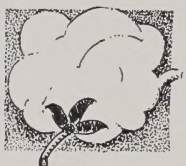
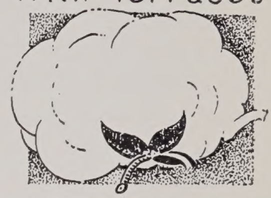
[1] Prevailing price each year.

In addition to the lint cotton, it is estimated that approximately 1,306 more pounds of cotton seed valued at $20 per ton were produced on the terraced area. The gross value of the increased yield

COTTON

at SPUR, Texas

YIELDS

Without Terraces	With Terraces
	
109 lb. per acre	**177 lb. per acre**

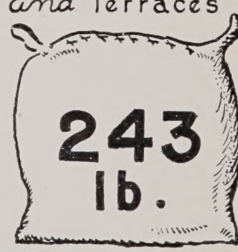
CASH RETURNS

Without Terraces	With Terraces
$ 12.18 per acre	**$ 19.78 per acre**

BEANS

at Mountainair, N.M.

YIELDS

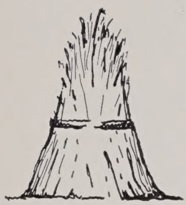
Without Treatment	With Contouring *and* Terraces
	
per acre	**per acre**

WHEAT

SOUTHERN GREAT PLAINS

YIELDS

Without Treatment



11.5 bu.
per acre

With Contouring *and* Terraces

15.1 bu.
per acre

GRAIN SORGHUMS

DALHART, TEXAS

YIELDS

Without Treatment

461 lb. per acre

With Contouring

589 lb. per acre

With Contouring *and* Terraces

723 lb. per acre

of lint and cotton seed was $104.29 per acre for the 12-year period, or $8.69 per year. After allowing for the added cost of harvesting and ginning the larger crop, an average annual balance of $6.51 per acre was the compensation (through increased yields) for terracing and contouring, which made it possible to hold all the water on the land. Similar returns have been reported by individual farmers from the use of these water-conservation practices.

Beans in a Mountain Valley of New Mexico

In the Estancia Valley of New Mexico, where the farmers grow corn, chile, and beans to supply their family needs, some fields have been terraced and cultivated on the contour for the past several years while others have been farmed in the old traditional ways. Measurements made by the Soil Conservation Service on a considerable number of both treated and untreated fields show clearly that contouring and terracing help to bring better bean yields in this country of limited rainfall (table 2). The acreages in the different fields were measured and the yields were determined by using the thrashing machine records for each field.

TABLE 2.—*Comparative bean yields from terraced and contoured fields and unterraced and noncontoured fields in Estancia Valley, N. Mex.,*[1] *1936–39*

Year	Rainfall	Unterraced fields with straight rows				Terraced and contoured fields				Difference in favor of treatment	
		Number of fields	Total acreage	Total yield	Yield per acre	Number of fields	Total acreage	Total yield	Yield per acre		
	In.		*Acres*	*Lb.*	*Lb.*		*Acres*	*Lb.*	*Lb.*	*Lb.*	*Pct.*
1936	15.42	34	3,015	775,356	257	19	860	247,702	288	31	12.1
1937	9.01	34	3,401	608,346	179	22	1,084	320,454	296	117	65.4
1938	11.11	34	2,859	290,526	102	21	1,212	212,022	175	73	71.6
1939	19.19	34	3,984	516,230	130	27	2,086	494,000	237	107	82.3
Total	54.73	136	13,259	2,190,458	668	89	5,242	1,274,178	996	328	
Average	13.68	34	3,315	547,615	167	22	1,311	318,545	249	82	49.1
Average yield all fields for 4-year period[2]					165				243	78	47.3

[1] Data from evaluation studies conducted during period from 1936–1939, inclusive, by the personnel at Mountainair, N. Mex., under the supervision of the Agronomy Division of the regional office at Albuquerque, N. Mex.

[2] Determined by dividing the total yield of all fields for the 4-year period by the total acreage.

The record of monthly precipitation (table 3), when checked against the annual yields in table 2, reveals the importance of seasonal distribution of rainfall. Despite the low total precipitation in 1937, for example, it will be noted that yields were reasonably good because much of the rain that fell came during the growing season. Conversely, yields in 1939 were not as good as might be expected with nearly 20 inches of rainfall, largely because of unsatisfactory seasonal distribution.

TABLE 3.—*Record of monthly precipitation 1936-39, inclusive, at Mountainair, N. Mex.*

Year	January	February	March	April	May[1]	June[1]	July[1]	August[1]	September[1]	October	November	December	Total
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1936	0.72	0.34	0.65	1.58	0	1.10	3.65	1.78	4.45	0.30	0	0.85	15.42
1937	.29	.70	1.08	.29	2.27	2.25	.15	.42	1.04	0	0	.52	9.01
1938	0	.10	.10	[2] T	[2] T	2.35	2.33	.36	3.57	.30	.95	1.05	11.11
1939	2.09	.56	1.52	1.07	.65	.83	3.68	3.08	2.70	1.45	.78	.78	19.19
Total													54.73

[1] Normal growing season, May to September.
[2] Trace.

Wheat in the Southern Great Plains

In 1938 the Soil Conservation Service made a study of wheat yields on contoured and terraced fields in comparison with yields from noncontoured and unterraced fields in the southern Great Plains. For purposes of the study seven erosion-control demonstration areas in four States were selected (table 4). The range of slope varied from 0 to 3 percent, and the soils were mainly silty clay loams and fine sandy loams. Although differences in cultural operations, time of seeding, and previous crops undoubtedly existed, it is believed that the sample of 178 fields studied is large enough to make the results significant.

Wheat yields on the unterraced and terraced fields were determined by using approved sampling methods, whereby the fields were stratified and a minimum of 10 samples were harvested from each area. The acreage reported by each terrace position, such as upper terrace channel, lower terrace channel, midway between

terraces, lower part of terrace interval, and terrace crown, was determined as was the acreage of separately sampled parts of unterraced fields.

TABLE 4.—*Summary of wheat yields from terraced and contoured fields and unterraced and noncontoured fields in the Southern Great Plains Region,*[1] *1939*

Location	Rainfall[2]	Unterraced fields, with straight rows				Terraced and contoured fields				Difference in favor of treatment
	July 1, 1938 to June 30, 1939	Number of fields	Acreage	Total yield	Acre-yield	Number of fields	Acreage	Total yield	Acre-yield	
	Inches		*Acres*	*Bushels*	*Bushels*		*Acres*	*Bushels*	*Bushels*	*Bushels*
Channing, Tex.	17.94	1	264	2,402	9.1	6	1,613	25,324	15.7	6.6
Clovis, N. Mex.	18.35	7	962	20,875	21.7	3	573	14,953	26.1	4.4
Guymon, Okla.	16.42	15	1,372	11,938	8.7	18	1,970	36,248	18.4	9.7
Liberal, Kans.	14.16	10	1,734	11,965	6.9	21	3,187	36,969	11.6	4.7
Perryton, Tex.	21.29	7	1,024	16,351	16.0	11	1,900	30,400	16.0	0
Stratford, Tex.	17.37	2	494	7,805	15.8	13	2,992	46,376	15.5	—.3
Vega, Tex.	18.65	22	2,594	25,940	10.0	42	6,014	85,400	14.2	4.2
Total		64	8,444	97,276	88.2	114	18,249	275,670	117.5	29.3
Average		9	1,206	13,897	12.6	16	2,607	39,381	16.8	4.2
Average yield all fields of the seven projects[3]					11.5				15.1	3.6

[1] Data from evaluation studies conducted on different projects under the supervision of the Agronomy Division of the regional office at Amarillo, Tex.

[2] Rainfall distribution shown in table 5.

[3] Determined by dividing the total yield from all fields on all projects by the total acreage.

In this study, the significance of seasonal rainfall distribution stands out even more clearly than in the Estancia Valley study. In two areas where the rainfall was especially well distributed (those near Perryton and Stratford, Tex.), there was little difference in yields between the treated and untreated fields. On the other hand, in the area near Guymon, Okla., where the rainfall was unusually low and poorly distributed, contouring and terracing produced the most marked differences in yields found in any of the areas. This suggests that on wheatfields of the southern Great Plains these practices are of greatest value during years of unfavorable rainfall. And it should be remembered that even in years of high or well-distributed rainfall they function efficiently in controlling soil erosion (table 5).

Table 5.—*Rainfall distribution for each of seven demonstration areas, by months, 1938 and 1939*

Location	Year	Jan.	Feb.	Mar. [1]	Apr. [1]	May [1]	June [1]	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
		In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Channing, Tex.	1938	0	0.59	0.88	1.36	1.44	2.75	1.73	0.81	3.33	3.08	(3)	0.19	16.16
	1939	(2)	.08	(2)	2.23	1.15	3.23	.68	3.04	.47	.79	0.12	.84	[2] 12.63
	Avg., 15 yrs.	.36	.51	.54	1.73	1.47	2.42	2.48	1.97	2.41	1.48	.99	.56	16.92
Clovis, N Mex.	1938	.52	.95	.96	(3)	.98	3.45	3.66	1.23	3.46	5.00	0	.11	20.32
	1939	1.94	.10	.54	.50	2.11	1.16	.90	4.62	.28	1.23	.33	.94	14.65
	Avg., 20 yrs.	.23	.46	.74	1.61	1.98	2.89	2.68	2.97	2.21	1.81	.45	.56	18.59
Guymon, Okla.	1938	(3)	.37	.70	.99	1.58	1.45	1.11	.75	5.06	1.38	(3)	.59	13.98
	1939	(2)	.23	1.11	1.77	.90	2.48	1.02	.86	.06	.147	.023	.60	[2] 9.20
	Avg., 7 yrs.	.40	1.96	.48	2.50	3.25	2.90	3.23	2.85	3.24	2.35	1.38	1.05	25.59
Liberal, Kans.	1938	0	.85	1.14	1.18	3.34	4.12	3.18	.38	4.37	.45	.21	.40	19.62
	1939	.87	.88	1.92	1.50	.95	2.56	2.32	1.29	.03	.27	.02	1.02	13.63
	Avg., 27 yrs	.20	.86	.73	1.50	2.62	2.75	2.98	2.48	1.98	1.51	.77	.70	19.08
Perryton, Tex.	1938	0	1.32	1.47	3.00	4.28	2.13	4.03	1.42	2.20	.62	.19	0	20.66
	1939	1.95	.40	1.10	2.32	2.07	4.99	2.72	2.16	0	.96	.04	1.05	19.76
	Avg., 26 yrs.	.26	1.12	.82	1.60	2.41	2.91	2.07	2.99	2.18	1.76	1.07	.69	19.88
Stratford, Tex.	1938	(3)	.60	.61	1.43	1.14	1.87	1.88	.55	4.48	2.54	.03	.58	15.71
	1939	1.30	.20	.19	3.65	.64	2.30	3.67	2.27	.33	.45	.09	.90	15.99
	Avg., 16 yrs.	.29	.80	.59	1.46	1.93	3.02	3.12	2.86	1.76	1.96	.54	.73	19.06
Vega, Tex.	1938	.24	1.45	.91	1.03	1.34	2.85	2.18	.10	1.89	4.32	.16	.27	16.74
	1939	2.91	.49	.22	1.92	1.58	4.62	1.50	3.51	.95	1.05	.13	1.55	20.43
	Avg., 8 yrs.	.38	.31	1.37	1.54	2.63	3.41	2.73	3.42	2.60	2.51	1.35	.79	23.04

[1] Period of maximum growth, March to June.

[2] No record of rainfall.

[3] Trace.

Grain Sorghums in the High Plains of Texas

The effect of contouring and terracing on yields of headed grain sorghums was studied by the Service in the demonstration area near Dalhart, Tex., in 1937. Although data [1] were gathered on

[1] The acre yield of grain for the different fields was determined by using the sampling method (with slight modification) described by Reynolds and Coldwell in the Journal of American Society of Agronomy, vol. 30, No. 8, August 1938. The fields were stratified in the same manner as described for the wheatfields.

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Terraces combined with contour farming provide maximum storage of rainfall and maximum protection for the soil.

only 48 fields, the technicians making the study report that a good cross section was obtained. Since the sandier soils in this area shed little or no rainfall, the study was confined to the heavier and finer textured soils where water conservation seemed more likely to be a significant factor. Total rainfall in the area during 1937 amounted to 14.48 inches; the previous year only 9.93 inches fell.

Yields on contoured and terraced fields were compared not only with those on untreated fields but also with those on fields which were contoured but not terraced. The results (table 6) show that contouring helps to produce better yields than no treatment and that the best results are secured by a combination of the two practices.

TABLE 6.—*Comparison of sorghum yields from fields with and without soil and moisture conservation treatments near Dalhart, Tex., in 1937*

Treatment	Number of fields	Area	Average yield per acre
		Acres	*Pounds*
Terraced and contoured	20	4,226	723
Contoured	21	4,035	589
Straight rows	7	882	461

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